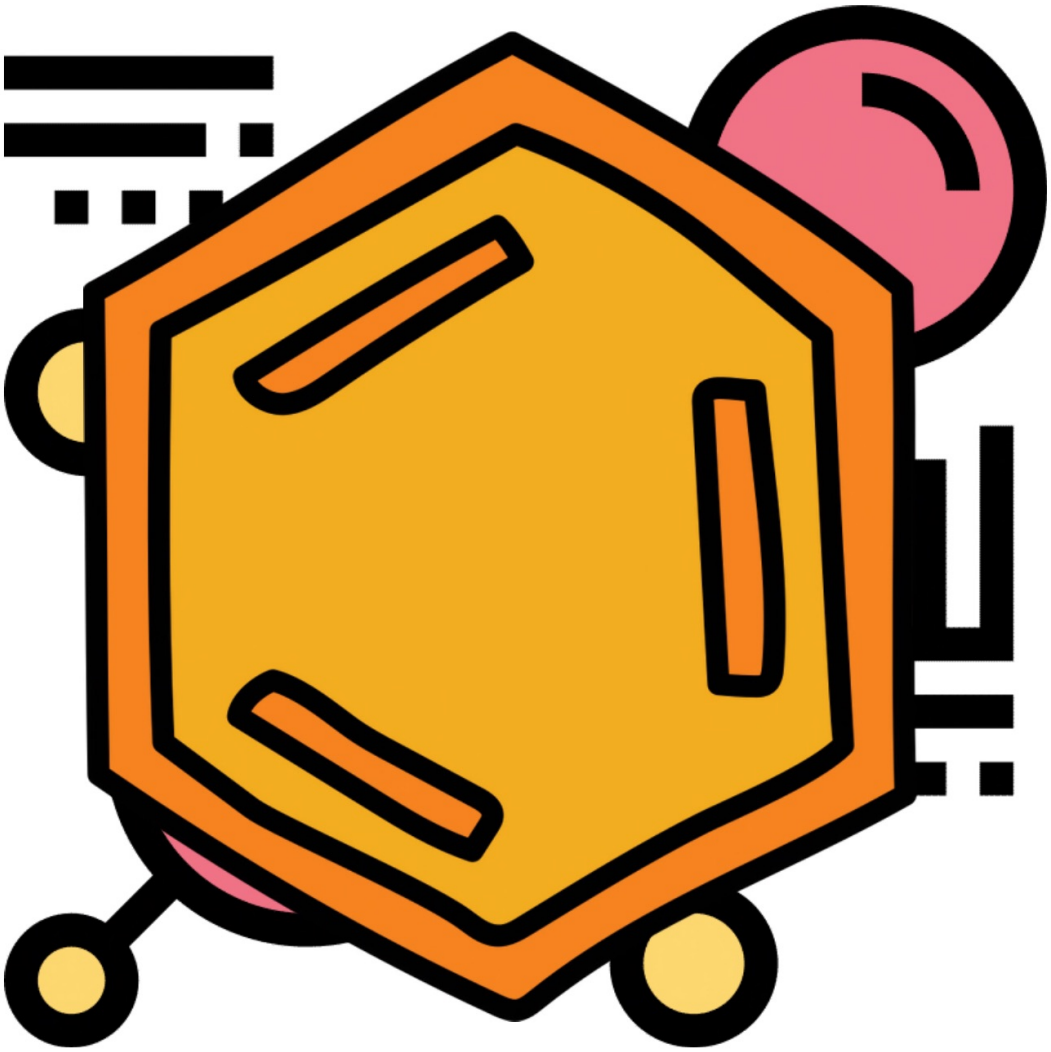
CARBON

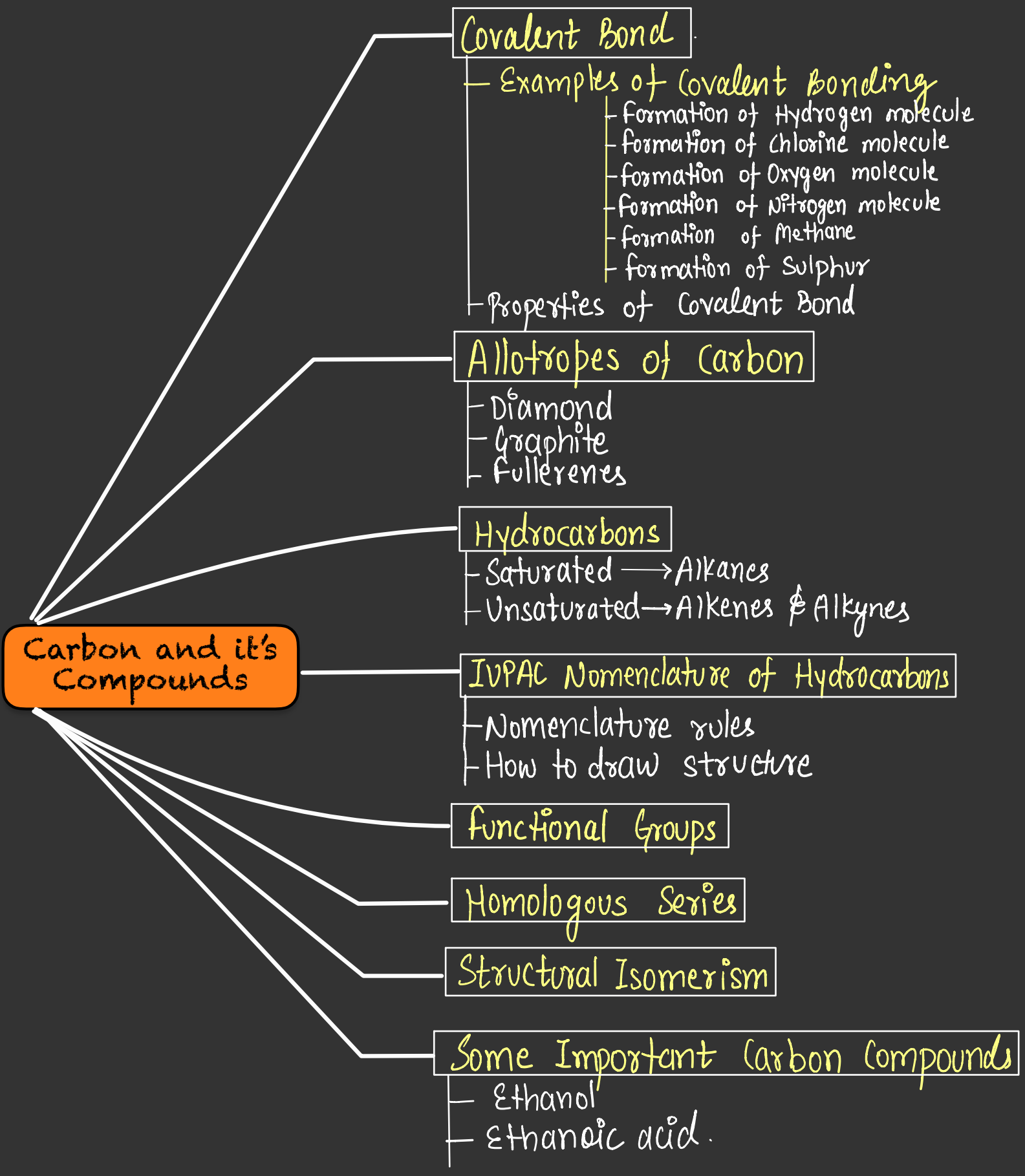
HANDWRITTEN NOTES

[Prv. Years Included]



Designed With ♥

Shobhit Nirwan


Carbon and it's Compounds
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Atomic number of Carbon = 6 (K, L)
∴ Its electronic configuration ⇒ 2, 4 → अभी ये stable नहीं है, क्योंकि stable होने के लिए $8e^{\ominus}$ चाहिए होंगे (in outermost shell) but यहाँ 4 ही है → अब या तो ये 4 gain कर लें या 4 lose कर दें।

- It could gain four electrons forming C^{4-} anion, but it would be difficult for the nucleus to hold six protons to hold on to ten electrons.
- It could lose four electrons forming C^{4+} cation, but it would require a large amount of energy to remove four electrons.

[CBSE 2019 2014] दोनों ही case fail होते हुए दिख रहे हैं Guyzz 😔 ; But 😊 अब Carbon गठबंधन करेगा!

Therefore, in order to overcome this problem, Carbon shares its valence electrons with other atoms of carbon or with atoms of other elements. These shared electrons belong to the outermost shells of both atoms and in this way, both atoms attain the nearest noble gas configuration. This type of bonding is called Covalent Bonding.

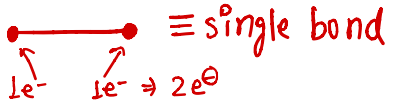
EXAMPLES OF COVALENT BONDING:-

[I] Formation of Hydrogen Molecule (H_2):

H_2, Atomic no. = 1 (K)
Electronic configuration = 1

Need 1 more $e^{\ominus}$ to fill K-shell completely. ∴ two H-atoms share their electrons to form a H_2 molecule, also it will attain nearest noble gas configuration ie of helium.

K³B* single bond (because दोनों एक एक $e^{\ominus}$ share करें।)



[II] Formation of Chlorine Molecule (Cl_2):-

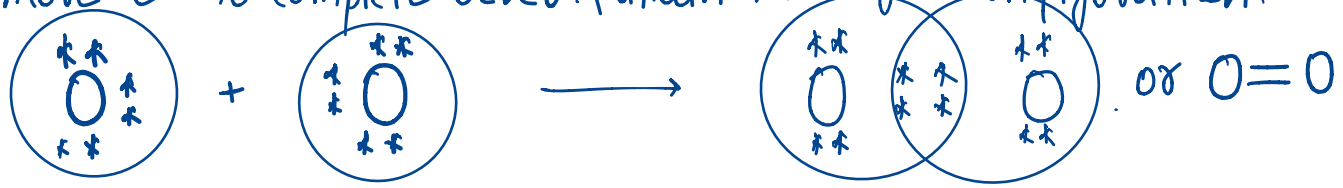
Cl_2, Atomic no. = 17
Electronic configuration ⇒ 2, 8, 7 (K, L, M)

Need 1 more $e^{\ominus}$ in outermost shell to complete octet.

[III] Formation of Oxygen Molecule (O_2):-

O_8 Atomic number = 8
Electronic Configuration = 2, 6 (K L)

Need 2 more $e^\ominus$ to complete octet & attain Noble gas Configuration.

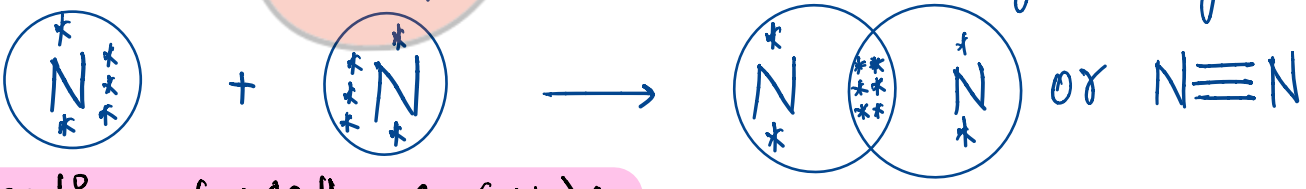


$2e^\ominus$ share → single bond (—)
$4e^\ominus$ share → double bond (=)
similarly if $6e^\ominus$ share?
↳ triple bond (≡)

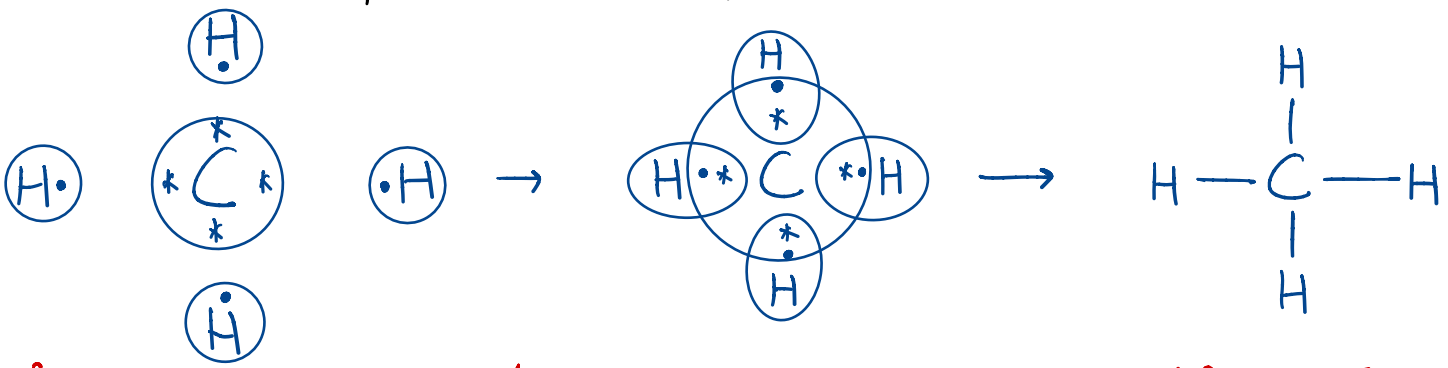
[IV] Formation of Nitrogen Molecule (N_2):-

N_9 Atomic No. = 7
Electronic Configuration = 2, 5 (K L)

Need 3 more $e^\ominus$s to complete octet & achieve noble gas configuration.



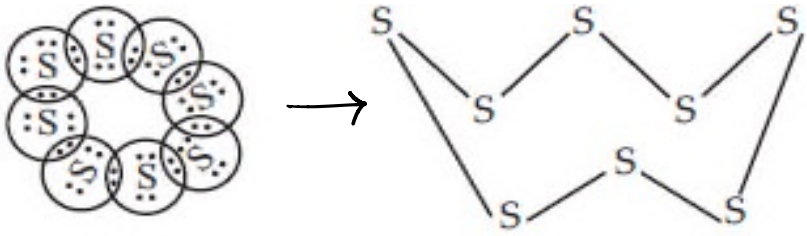
[V] Formation of Methane (CH_4):



K³B ⇒ Methane also called marsh gas, used as a fuel and is a major component of CNG (Compressed Natural Gas) and Biogas.

चलो अब इन compounds के अपने आप बनाओ:-
→ Ammonia (NH_3)
→ Water (H_2O)
→ Carbon Dioxide (CO_2)

[VI] formation of Sulphur (S_8):-



Ring structure of S_8 molecule

Crown shape of S_8 molecule

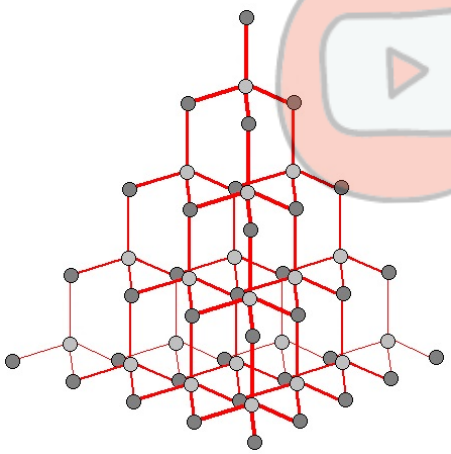
Properties of Covalent Bond: [cbse 2019, 2018]

- Low melting and boiling points (∵ weak inter molecular forces).
- As electrons are shared between atoms and no charged particles are formed in these compounds.

Allotropes of Carbon

↳ Allotropy is the property by which an element exists in more than one form and each form has different physical Properties but identical chemical prop.

DIAMOND



GRAPHITE

graphite

Property-

- Very Hard
- Non-conductor of Electricity
- Colourless transparent

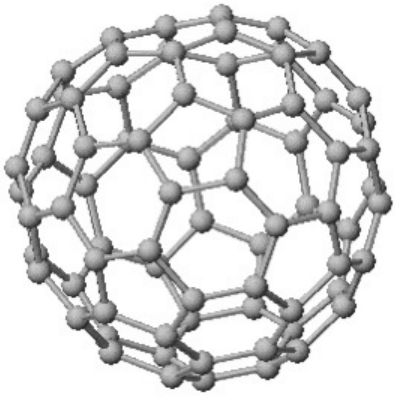
- lighter than diamond, slippery
- Conduct Electricity
- Greyish black, opaque

Uses-

- Used as a cutting instrument
- Making jewellery

- Used as a lubricant
- Used in electric cell
- To make core of pencil.

Fullerenes: Fullerene (C_{60}) was named Bukminster fullerene. The first known fullerene was C_{60} which contains 60 carbon atoms.



K³B ⇒ CARBON के इतने Jalwe क्यू है? OR,
What are the factors that enables carbon to form large no. of Compounds?
OR, Versatile Nature of Carbon:- [cbse 2020]

1. CATENATION: Carbon has a self-linking property in which C-atoms links through covalent bonds to form long, straight or branced chains and rings. Carbon shows maximum catenation in the periodic table due to its small size and strong C-C bond.

2. TETRAVALENCY OF CARBON: Carbon has 4 $e^{\ominus}$s in outermost shell. Hence, its valency is four i.e. it is capable of bonding or pairing with four other carbon atoms or with the atoms of some other monovalent elements like hydrogen, halogen (chlorine, bromine) etc.

3. TENDENCY TO FORM MULTIPLE BONDS: Due to its small size carbon has a strong tendency to form multiple bonds (double and triple bonds) by sharing more than on $e^{\ominus}$ pair with its own atoms or with the atoms like Oxygen, nitrogen etc.

✱ ⇒ Compounds of Carbon are called Organic Compounds.

Hydrocarbons [cbse 2017, 2012]

A compound made of hydrogen and carbon only is called hydrocarbon.
Types of Hydrocarbons -

1. SATURATED: Compounds of carbon which are linked only by single bonds between the carbon atoms.
Types of Saturated hydrocarbons — Alkanes.

2. UNSATURATED: Compounds of carbon having double or triple bonds between their carbon atoms.
Types of Unsatured hydrocarbons - Alkenes, Alkynes.

Now:-

(i) Alkanes: The hydrocarbons in which all the carbon atoms are linked by only single covalent bonds are called alkanes or paraffins.
General formula ⇒ C_nH_{2n+2}

(ii) Alkenes: Those unsaturated hydrocarbons which have atleast one double bond alongwith single bonds are called alkenes or Olefins.
General formula ⇒ C_nH_{2n} $[n>1]$

(iii) Alkynes: Those unsaturated hydrocarbons which have one or more triple bonds

alongwith the single bonds are called alkynes.
General formula: C_nH_{2n-2} $[n>1]$

* here $[n>1]$ i.e minimum no. of carbon for double or triple bond must be two.
↳ सिर्फ एक carbon से double/triple bond कैसे लाओगे!

IUPAC Nomenclature of Hydrocarbons (नामकरण)

↳ नामकरण करने के लिए :- PREFIX + SUFFIX → बस यही करना है!

→ Prefix is based on number of carbon atoms in the chain.

#RattaMaaroLo :

		Prefix
C_1	→	Meth
C_2	→	Eth
C_3	→	Prop
C_4	→	But
C_5	→	Pent
C_6	→	Hex

→ Suffix is based on if hydrocarbon is alkane, alkene, alkyne.

#RattaMaaroLo :

		Suffix
Alkane	→	ane
Alkene	→	ene
Alkyne	→	yne

Method : ○ Suffix तो आराम से total no. of carbon से निकल जाएगा।
○ कौनसा hydrocarbon है ये पता चलेगा कि वो जो तुम्हें compound दिया है वो कौनसी formulae से बना है (like C_nH_{2n+2}, C_nH_{2n}, C_nH_{2n-2})

eg : C_2H_4 — Carbon → 2 ∴ "Eth" is prefix
If we put n=2 in C_nH_{2n} we get C_2H_4 → ∴ its alkene → ∴ "ene" is suffix.
∴ Name → Prefix + Suffix → Ethene

C_5H_{12} — Prefix → "Pent"
Suffix → "ane" [∵ put n=5 in C_nH_{2n+2} to get C_5H_{12}] → Pentane

$CH_3(H_2(CH_3$ — (पहले clup-up कर के simplify कर लो।)
≡ C_3H_8
↳ Now, Prefix → "prop"
Suffix → "ane" → propane

C_3H_4 — Prefix → "Prop"
Suffix → "yne" → Propyne

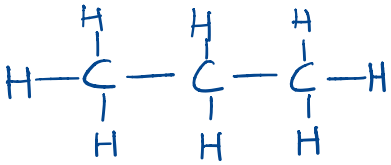
→ [cbse 2015]

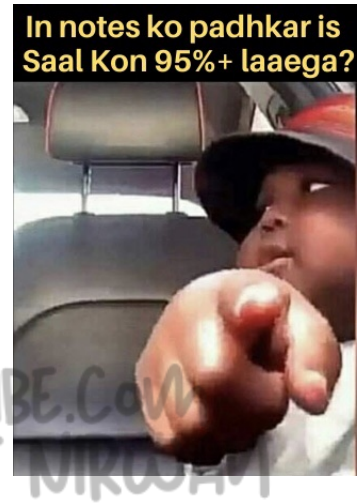
HOW TO DRAW STRUCTURE OF SATURATED AND UNSATURATED COMPOUNDS:

(i) Connect all the carbon atoms together with single bond.
(ii) After that use the hydrogen atoms to satisfy the remaining valencies of carbon (as we know, carbon forms 4 bonds due to its 4 valency).
(iii) If number of available H-atoms are less than what is required, satisfy remaining valency by using double or triple bond.

↳ Trick ⇒ पहले ही जाँच लो कि Alkane, alkene या Alkyne है → formulae से!
तो फिर पहले ही तुम्हें पता होगा की double, triple या कौनसा Bond होगा।

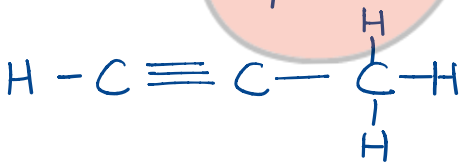
eg (i) C_3H_8 ⇒ Name → Propane
↳ all single bonds. ∴ Simple ऊपर वाले steps follow करो





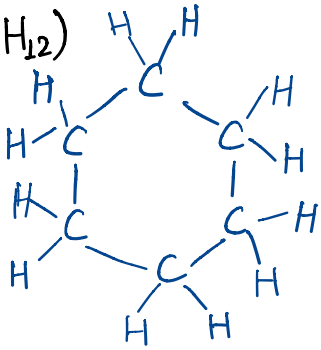
(ii) C_2H_4 → Ethene
↳ 1 double bond

(iii) C_3H_4 → Propyne
↳ 1 Triple bond.

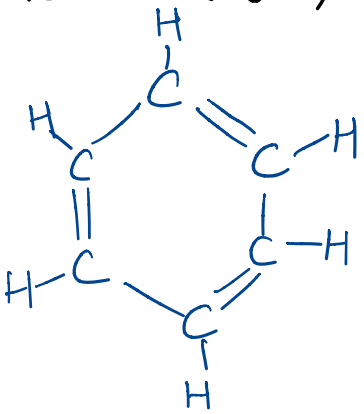


← [Triple bond दोनों में से किसी भी जगह लगा सकते थे, बस Triple bond और Hydrogen लगाते हुए एक बात ध्यान रखना कि Carbon के 4 से ज्यादा Bond ना बन जाए।]

(iv) Cyclohexane (C_6H_{12}) [cbse 2018]



** (v) Benzene (C_6H_6) (Ratt lo)



Functional Groups

↳ An atom or group of atom that makes a carbon compound reactive and decides its chemical property is called a functional group.
↳ [cbse 2016]

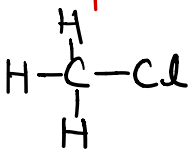
for Nomenclature: If functional group is present in the compound, it is indicated in the name of the compound with either a prefix or suffix (given on next page)

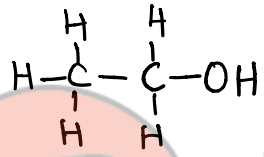
Hetero atom	Functional group	Formula of functional group	Prefix/Suffix
Cl/Br	Halo- (Chloro/bromo)	—Cl, —Br (substitutes for hydrogen atom)	Prefix – Chloro, Bromo
Oxygen	1. Alcohol	—OH	suffix – ol
	2. Aldehyde		suffix – al
	3. Ketone		suffix – one
	4. Carboxylic acid		suffix – oic acid

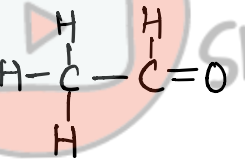
→ [cbse 2014]

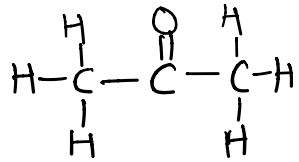
∴ for nomenclature do → Prefix + Hydrocarbon
or, Hydrocarbon + Suffix

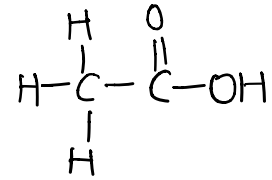
In suffix case, delete the final 'e' and add the appropriate suffix.

eg CH_3Cl or  ⟹ Prefix + Hydrocarbon
⇒ Chloroethane

CH_3CH_2OH or  ⟹ Hydrocarbon + suffix (but delete 'e')
Ethane $\xrightarrow[-e]{+ol}$ Ethanol

CH_3CHO or  ⟹ Hydrocarbon + suffix
Ethane $\xrightarrow[-e]{+al}$ Ethanal

CH_3COCH_3 or  ⇒ Propane $\xrightarrow[-e]{+one}$ Propanone

CH_3COOH or  ⇒ Ethane $\xrightarrow[-e]{+oic\ acid}$ Ethanoic acid

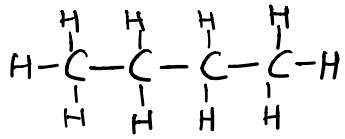
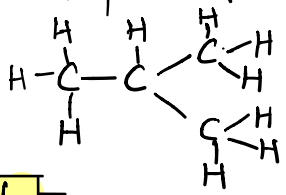
Homologous Series [cbse 2017, 2013]

↳ A homologous series is a group of organic compounds having similar structure and chemical property in which successive compound group differ by $-CH_2$ group.
eg:- CH_4, C_2H_6, C_3H_8 ----

Characteristics:
- All members are represented by same General formula
- 2 adjacent members differ by $-CH_2$ group.
- 2 adjacent members differ by mol. masses of 14u.
- All shows similar chemical properties. (but not physical)

STRUCTURAL ISOMERISM

↳ Compounds with identical molecular formula but different structures

eg  &  → Both C_4H_{10} but connectivity अलग है ∴ they both are Isomers.

Some Important Carbon Compounds

[I] Ethanol (CH_3CH_2OH):

- Liquid, soluble in water
- Commonly called alcohol and is active ingredient
- As it is a good solvent, it is used in medicines such as tincture iodine, cough syrups and many tonics.
- Preparation — Obtained by fermentation of molasses which are obtained from sugarcane juice

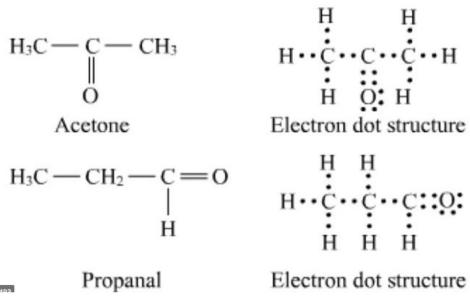
[II] Ethanoic Acid (CH_3COOH):

- Commonly called acetic acid.
- 5-8% solution of acetic acid in water is called vinegar which is used as presentation in pickle.
- Melting point 290 K, so freezes during winter.
- Carboxylic acid are weak acids.

⇒ Some Important Lallu Problems:

CBSE 2013 (b) Draw two possible isomers of the compound with molecular formula C_3H_6O and write their names.

ans →



K3B

- frozen acetic acid (CH_3COOH) is also called glacial acetic acid.

- DENATURED ALCOHOL: Consumption of Alcohol in large quantity is not good for health. It tends to slow metabolic processes and depress the central nervous system which in turn results in lack of coordination, drowsiness etc. Therefore, in order to stop misuse of alcohol, it is made unfit for drinking by adding poisonous substances like methanol, pyridine etc and coloured substances likes dyes. Such alcohol is called denatured alcohol.

KHATAM